ANNEXES TO THE

PRELIMINARY EXAMINATION REPORT

(ARTICLE 34 AMENDMENTS)

Commissioner for Patents
P.O. Box 1450
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Sir:

REQUEST FOR SUBSTITUTION OF REPLACEMENT SHEETS

Please substitute the attached replacement sheets 4, 5, 5-1, 6, 6-1, 6-2, 8, 9, 10, 11, 12, 13, 14, 14-1, 15, 15-1, 16, 18, 21, 29, 38, 44, 45, 55, 55-1, 56, 57, and 58 of the specification containing the Article 34 Amendments for sheets 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 21, 29, 38, 44, 45, 55, 56, 57, and 58 of the specification in the enclosed as-filed PCT application and replacement sheets 60, 61, 62, 63, 64, and 65 of the claims containing the Article 34 Amendments for sheets 60, 61, 62, 63, 64, and 65 of the claims in the enclosed as-filed PCT application. Claims 1-18 as set forth in the accompanying Replacement Sheets are currently pending.

Respectfully submitted,

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REPLACEMENT SHEETS

- Amendments filed on November 14, 2005 and March 24, 2006 pursuant to Article 34 PCT -

Then, the present invention has been developed to solve the problem of the above-mentioned conventional technology, and takes notice of the output characteristic of the pyroelectric infrared sensor, and aims at providing an information recognition device, an information recognition method, and an information recognition program, and an alarm system having the information recognition device capable of recognizing predetermined information associated with an object-to-be-detected, according to output of thermal radiation detection means for an object-to-be-detected existing in a detection range and behavior pattern model corresponding to the output of the thermal radiation sensor corresponding to behavior patterns of objects prepared in advance by using a predetermined modeling method.

Disclosure of Invention

To attain the above-mentioned objectives, the information recognition device according to claim 1 of the present invention includes:

thermal radiation detection means for detecting, by a thermal radiation sensor, the thermal radiation emitted from an object-to-be-detected having plural different pieces of attribute information existing in a detection range;

behavior pattern model storage means for storing a behavior pattern model obtained by modeling output of the thermal radiation sensor depending on a behavior pattern of an object-to-be-detected by using a predetermined modeling method; and

information recognition means for recognizing plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result of the thermal radiation detection means and the behavior pattern model stored in the behavior pattern model storage means, wherein

the information recognition means extracts the feature data from the detection result of the thermal radiation detection means, calculates the likelihood between the feature data and the behavior pattern model based on the feature data and the behavior pattern model stored in the behavior pattern model storage means, and recognizes plural different pieces of attribute information relating to the object-to-be-detected based on the calculated likelihood.

With the configuration, the thermal radiation detection means can detect thermal radiation emitted from an object-to-be-detected existing in a detection range using a thermal radiation sensor, the behavior pattern model storage means can store a behavior pattern model obtained by modeling in advance the output of the thermal radiation sensor depending on a behavior pattern of the object-to-be-detected by using a predetermined modeling method, and information recognition means can recognize plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result of the thermal radiation detection means and the behavior pattern model stored in the behavior pattern model storage means.

The information recognition means can extract the feature data from the detection result of the thermal radiation detection means, calculate the likelihood between the feature data and the behavior pattern model based on the feature data and the behavior pattern model stored in the behavior pattern model storage means, and recognize plural different pieces of attribute information relating to the object-to-be-detected based on the calculated likelihood.

Therefore, the likelihood between the feature data of the detection result and the behavior pattern model is calculated based on the detection result of the thermal radiation sensor and the behavior pattern model, and plural different pieces of attribute information about the object-to-be-detected can be recognized based on the calculated likelihood. As a result, various types of attribute information such as the type of an object-to-be-detected, etc. can be easily recognized.

An object-to-be-detected can be anything that emits thermal radiation, for example, a person, other lives such

as an animal, an insect, etc. other than a person, nonlife, etc.

A thermal radiation sensor can be anything that detects heat emitted from an object-to-be-detected. For example, an infrared sensor for detecting infrared emitted from an object-to-be-detected can be a quantum sensor using a photovoltaic effect or a photoconductive effect, or a thermo-sensor using a thermoelectromotive effect, a pyroelectric effect, a pyroconductive effect, etc.

A predetermined modeling method can be, for example, a well-known HMM, a neural network, etc.

The plural different pieces of attribute information are, for example, the information globally about lives emitting heat such as a person, animals (mammals) other than persons, an insect, etc., nonlives emitting heat of warm wind and cold wind of a vehicle, a bike, a curtain, solar light, a light, an air-conditioner, etc.

The information about nonlives not emitting heat such as the movement of a curtain, branches, leaves, etc. can be included in the plural different pieces of attribute information. The recognition of the predetermined information about a nonlife not emitting heat can be performed by a combination with an object emitting heat. For example, when there is a thermal radiation sensor on one side of a curtain, and there is a heat source on the other side, the heat emitted from the heat source is not detected by the sensor when the heat source is covered with the curtain. When the curtain is moved and the heat source is disclosed, the heat emitted

from the heat source is detected by the sensor. This phenomenon is utilized. That is, by comparing the detection result with the behavior pattern, it can be determined whether the event refers to the movement of a curtain or the invasion of a person into a building.

On the other hand, locally, for a person, there is the information about the type of person, for example, a man, a woman, an adult, a child, etc. For an animal, there is the information about the type of a dog, a cat, a rat, a bird, etc. For an insect, there is the information about the type of a butterfly, a spider, a grig, a beetle, a stag beetle, etc. Furthermore, the specific information about each type is described. Furthermore, the lives other than persons can also be type-divided as with the persons.

When the plural different pieces of attribute information are specific information, a person can be identified for an individual, and an insect and an animal can be identified for a unit.

The invention according to claim 2 is based on the information recognition device described in claim 1, wherein the behavior pattern model storage means stores plural behavior pattern models depending on respective types of behavior patterns.

That is, since a recognizing process can be performed based on plural behavior pattern models depending on the respective types of behavior patterns and a detection result, various types of information about an object-to-be-detected in the detection range can be recognized.

The invention according to claim 3 is based on the information recognition device described in claim 1 or 2, and

cell, etc., a sensor using a photoconductive effect by using a CdS cell, a CdSe cell, a PdS cell, etc., a sensor using a photoemission effect by using a photoelectric tube, a photomultiplier tube, etc.

The invention according to claim 6 is based on the information recognition device described in claim 4, and the thermo-sensor is a pyroelectric infrared sensor for detecting infrared emitted from the object-to-be-detected using a pyroelectric effect.

That is, since a pyroelectric infrared sensor is used as a thermal radiation sensor, a moving object in a detection range can be easily detected.

The invention according to claim 7 is based on the information recognition device described in one of claims 1 to 6, and the predetermined modeling method is an HMM (Hidden Markov Model).

That is, by modeling the behavior pattern using the HMM as a probability model of a time series signal, an unsteady time series signal can be easily modeled. Therefore, the behavior pattern of an object-to-be-detected can be appropriately modeled.

REPLACEMENT SHEET

The invention according to claim 11 is based on the information recognition device described in any of claims 1 to 7, and the feature data includes first feature data constituted by a spectrum in a frame unit of a detection result of the thermal radiation detection means and second feature data constituted by an average amplitude value of the spectrum in the frame unit.

That is, the likelihood of the behavior pattern model for the first feature data constituted by the spectrum in a frame unit of a detection result and the second feature data constituted by an average amplitude value of the spectrum in the frame unit is calculated, and plural different pieces of attribute information relating to the object-to-be-detected is recognized based on the calculation result, thereby improving the recognition accuracy of the attribute information.

The invention according to claim 12 is based on the information recognition device described in claim 11, and the

first feature data is obtained by transforming a value of the spectrum in the frame unit into a value of a common logarithm.

That is, since the value of the spectrum in the frame unit is transformed into the value of a common logarithm as the first feature data, the spread range is expanded if the value of the spectrum is smaller than 1, and the spread range is reduced if it is 1 or more. Thus, depending on the condition, the recognition accuracy of plural different pieces of attribute information can be furthermore improved.

The invention according to claim 13 is based on the information recognition device described in claim 11 or 12, and the feature data further includes third feature data constituted by a difference between feature indicated by the first feature data of a selected frame and feature indicated by the first feature data of the frame immediately before the selected frame.

That is, in addition to the first and second feature data, the third feature data constituted by the difference between the feature indicated by the first feature data of a selected frame and the feature indicated by the first feature data of the frame immediately before the selected frame is used to recognize plural different pieces of attribute information. Therefore, the recognition accuracy of the attribute information can be furthermore improved.

The invention according to claim 14 is based on the information recognition device described in claim 13, and the feature data further includes fourth feature data constituted by a difference between feature indicated by the second feature

data of a selected frame and feature indicated by the second feature data of the frame immediately before the selected frame.

That is, in addition to the first to third feature data, the fourth feature data constituted by the difference between the feature indicated by the second feature data of the selected frame and the feature indicated by the second feature data of the frame immediately before the selected frame is used to recognize plural different pieces of attribute information, thereby furthermore improving the recognition accuracy of the attribute information.

The invention according to claim 15 is based on the information recognition device described in any of claims 1 to 7 and claims 11 to 14. When the behavior pattern model is constituted by the feature data of a high dimension of four or more, the device includes:

feature data display means for displaying the feature data corresponding to each behavior pattern model stored in the behavior pattern model storage means as a coordinate point in a two- or three-dimensional space; and

detection result display means for displaying a coordinate point corresponding to a detection result of the thermal radiation detection means in a space in which the coordinate point of the feature data is displayed.

That is, when the behavior pattern model is constituted by the feature data of a high dimension of four or more, the feature data display means can display the feature data corresponding to each behavior pattern model stored in the

behavior pattern model storage means as a coordinate point in the two- or three-dimensional space, and the detection result display means can display a coordinate point corresponding to the detection result of the thermal radiation detection means in the space in which the coordinate point of the feature data is displayed.

Therefore, a detection result can be visually understood by comparing it with the feature data corresponding to the behavior patterns of other plural objects-to-be-detected, and plural different pieces of attribute information can be visually recognized.

The information recognition method according to claim 16 of the present invention includes:

detecting, by a thermal radiation sensor, thermal radiation emitted from an object-to-be-detected having plural different pieces of attribute information existing in a detection range;

preparing a behavior pattern model obtained by modeling output of the thermal radiation sensor depending on plural types of behavior patterns of plural objects-to-be-detected by using a predetermined modeling method; and

recognizing plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result of the thermal radiation sensor and the behavior pattern model, wherein

in recognizing plural different pieces of attribute information, feature data is extracted from the detection result of the thermal radiation sensor, the likelihood between

the feature data and the behavior pattern model is calculated based on the feature data and the behavior pattern model, and plural different pieces of attribute information relating to the object-to-be-detected is recognized based on the calculated likelihood.

The present invention can be realized by an information recognition device, etc. described in claim 1. Since the effects of the invention are the same as those described above, the explanation is omitted here.

The information recognition program according to claim 17 of the present invention includes:

a thermal radiation detecting step of detecting, by a thermal radiation sensor, thermal radiation emitted from an object-to-be-detected having plural different pieces of attribute information existing in a detection range;

a behavior pattern model storing step of storing a behavior pattern model obtained by modeling output of the thermal radiation sensor depending on plural types of behavior patterns of plural objects-to-be-detected by using a predetermined modeling method; and

an information recognizing step of recognizing plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result in the thermal radiation detecting step and the behavior pattern model stored in the behavior pattern model storing step, wherein

in the information recognizing step, feature data is extracted from the detection result in the thermal radiation detecting step, the likelihood between the feature data and the behavior pattern model is calculated based on the feature data and the behavior pattern model stored in the behavior pattern model storing step, and plural different pieces of attribute information relating to the object-to-be-detected is recognized based on the calculated likelihood.

The present invention is a program that can be applied to the information recognition device described in claim 1.

Since the effects of the invention are the same as those described above, the explanation is omitted here.

To attain the above-mentioned objective, the alarm system described in claim 18 includes the information recognition device described in any of claims 1 to 7 and claims 11 to 15;

determination means for determining whether or not the object-to-be-detected is a person based on the recognition result of the information recognition device; and

alarm means for raising an alarm when the determination means determines that the object-to-be-detected is a person.

With the above-mentioned configuration, the determination means can determine whether or not the object-to-be-detected is a person based on the recognition result of the information recognition device, and the alarm means can raise an alarm when it is determined that the object-to-be-detected is a person.

Therefore, based on the recognition result of the information recognition device capable of recognizing various types of attribute information such as the type of an object-to-be-detected, etc., discrimination between a person and an animal, etc. can be performed. Therefore, the present system can be used for guard of a building at a lower frequency of raising an erroneous alarm by mistakenly determining the invasion of an animal, etc. other than a person into a building.

The "raising an alarm" refers to giving an alarm message by voice through a speaker, etc., continuously providing peculiar sound such as a buzzer sound, etc., and includes an alarm as a threat and a warning to be given to an invader, and an alarm to a system user about the danger to be directly given to the system user by voice or on the screen display when the invasion of a person into a building is detected. The alarm to an invader and the alarm to a system user can be used independently of collectively.

Brief Description of the Drawings

Figure 11 shows a recognition result in the behavior direction according to the third embodiment of the present invention;

Figure 12A and Figure 12B show recognition results in the behavior direction according to the fourth embodiment of the present invention;

Figure 13 shows an example of displaying amount of information in a two-dimensional projection;

Figure 14 is a flowchart of the operating process of a two-dimensional projection unit 14;

Figure 15 is a block diagram of the configuration of the alarm system according to the fourth style of embodiment of the present invention; and

Figure 16 is a flowchart of the operating process of an alarm notification control unit 50.

Best Mode for Carrying Out the Invention

<First Style of Embodiment>

The first style of embodiment of the present invention is explained below by referring to the attached drawings. Figures 1, 2A to 2C, and 3 to 6 show the first style of embodiment of the information recognition device according to the present invention.

First, the configuration of the information recognition device according to the first style of embodiment of the present invention is explained by referring to Figure 1. Figure 1 is a block diagram showing the configuration of the information

the behavior pattern and the attribute of the object-to-be-detected is recognized.

In this style of embodiment, the pyroelectric infrared sensor 10a projects four pyroelectric elements by a Fresnel lens with 16 surfaces to enlarge the detection range. The detection range 20 is determined by an x horizontal axis and a y vertical axis as shown in Figure 2B, and covers about 7 m in the x direction and about 6 m in the y direction. That is, as shown in Figure 2B, the infrared from the object-to-be-detected passing any of plural detection zones in the range can be detected.

Furthermore, according to this style of embodiment, a behavior pattern of an object-to-be-detected can be detected as an object-to-be-detected walking in the detection range 20 in each direction of (1) to (8) from outside the detection range 20 as shown in Figure 2C.

In this style of embodiment, plural objects-to-be-detected (persons in this style of embodiment) are asked to take the above-mentioned eight behavior patterns in advance (for example, each person takes each pattern five times), a detection result from the pyroelectric infrared sensor 10a obtained from the acts of the behavior patterns is signal-processed by the signal processor 10b, the feature data is calculated, and the behavior pattern model generation unit 12 models the feature data corresponding to each behavior pattern by the HMM.

Additionally, in this style of embodiment, the signal processor 10b samples an analog output signal 30 of the data

signal processing is performed on the output signal of the detection result, and the behavior pattern model generation unit 11 generates a behavior pattern model corresponding to the contents of the behavior pattern of each object-to-be-detected and the attribute of the object-to-be-detected from the detection result after the signal processing using the HMM, and the model can be stored in the behavior pattern model storage unit 12.

The recognition unit 13 can recognize the behavior pattern and the attributes of an object-to-be-detected based on the infrared detection result of the object-to-be-detected operating in the detection range 20 by the infrared detection unit 10 and the behavior pattern model stored in the behavior pattern model storage unit 12.

The infrared detection unit 10 shown in Figure 1 corresponds to the thermal radiation detection means described in claim 1 or 11. The behavior pattern model generation unit 11 corresponds to the behavior pattern model generation means described in claim 3, the behavior pattern model storage unit 12 corresponds to the behavior pattern model storage means described in claim 1 or 2, and the recognition unit 13 corresponds to the information recognition means described in claim 1.

<First Embodiment>

Furthermore, by referring to Figures 7 and 8, the first embodiment of the present invention in which the information recognition device 1 according to the first style of embodiment

contents of the behavior pattern of each object-to-be-detected and the attribute of the object-to-be-detected by the HMM from the signal processed detection result, and stores it in the behavior pattern model storage unit 12.

Then, the behavior pattern model generation unit 11 can generate a behavior pattern model using the first to fourth feature data.

The recognition unit 13 can recognize the behavior pattern and the attribute of an object-to-be-detected based on the infrared detection result by the infrared detection unit 10 of the object-to-be-detected operating in the detection range 20, and the behavior pattern model stored in the behavior pattern model storage unit 12.

The infrared detection unit 10 shown in Figure 1 corresponds to the thermal radiation detection means described in claim 1 or 11. The behavior pattern model generation unit 11 corresponds the behavior pattern model generation means described in Figure 3. The behavior pattern model storage unit 12 corresponds to the behavior pattern model storage means described in claim 1 or 2. The recognition unit 13 corresponds to the information recognition means described in claim 1.

<Third Embodiment>

Furthermore, by referring to Figure 11, the third embodiment of the present invention in which the information recognition device 1 according to the above-mentioned second style of embodiment is applied to recognize the eight behavior

A practical operation is explained by referring to Figure 13. Figure 13 shows a display example of the feature data expressed in the two-dimensional projection. In this example, the first feature data is obtained as a result of five-time processes on the behavior patterns (1) to (8) described above for each of the persons A to Q in the first style of embodiment. Therefore, five pieces of feature data (coordinate point of the same shape shown in Figure 13) is displayed in the two-dimensional projection for each of the persons A to Q on one behavior pattern.

The two-dimensional projection unit first calculates (for each process) the mathematical distance between the first feature data for the behavior pattern of five processes on the persons A to Q, and stores the result in the data storage unit not shown in the attached drawings.

Upon receipt of the signal processing result (second feature data) from the infrared detection unit 10, the mathematical distance between the second feature data and the first feature data is calculated based on the feature data and the feature data about the five processes of the persons A to Q. Then, the mathematical distance between the first feature data for A to Q stored in the data storage unit is read, and using the read data and the Sammons method on the mathematical distance between the first feature data and the second feature data to two-dimensionally project each piece of feature data with correlation of the mathematical distances maintained. The coordinate information generated in the

two-dimensional projection is input to the information display unit.

The information display unit displays the acquired coordinate information using a coordinates point of a different shape for each attribute as shown in Figure 13. In Figure 13, coordinates 40 indicate the second feature data, and a frame 41 in Figure 13 shows the relationship between the shape of the respective coordinate points and A to Q. As shown in Figure 13, the second feature data (star-shaped coordinate point) is displayed in the position closest to the black diamond shape of A. Therefore, the display contents of the coordinate pointing the two-dimensional projection show that the detection result is closest to the attribute A. That is, an operator, etc, sees the displayed contents of a coordinate point to recognize or predict the attribute (A in this case) of an object that has traversed the detection range 20.

The persons in the positions of similar coordinate points in the two-dimensional projection can be regarded as belonging to the same category, and by generating a behavior pattern model using the HMM, the categories of persons can be classified. There are various categories, and classification can be performed depending on the common features of persons in the close positions such as the way of walking, the body type, the walking speed, the walking direction, etc. The method can be applied not only to persons, but also to all objects emitting infrared, and can be applied in discriminating a person from an animal, and discriminating all objects.

In the third style of embodiment, the multidimensional feature data is projected on the two-dimensional coordinate information. However, the present invention is not limited to this application, and multidimensional feature data can be projected on the three-dimensional coordinate information.

Industrial Applicability

According to the information recognition device described in claim 1 of the present invention, based on the detection result of the thermal radiation sensor and the behavior pattern model, plural different pieces of attribute information about the object-to-be-detected can be recognized. As a result, various types of attribute information such as the type of an object-to-be-detected, etc. can be recognized. Furthermore, since the likelihood between feature data and the behavior pattern model is calculated, and predetermined information about the object-to-be-detected is recognized based on the likelihood, the predetermined information can be easily recognized.

According to the information recognition device described in claim 2, in addition to the effects described in claim 1, the recognizing process can be performed based on plural behavior pattern models depending on plural types of behavior patterns and detection results. Therefore, various types of information about objects-to-be-detected in the detection range can be recognized.

According to the information recognition device described in claim 3, in addition to the effects in claim 1

or 2, a new behavior pattern model can be easily added, and since a behavior pattern model can be generated depending on a given condition, flexible action can be taken in changing

a behavior pattern model by changing the contents of recognition.

According to the information recognition device described in claim 6, in addition to the effects described in any of claims 1 to 3, a pyroelectric infrared sensor is used as a thermal radiation sensor. Therefore, a mobile object in a detection range can be easily detected.

According to the information recognition device according to claim 7, in addition to the effects described in any of claims 1 to 6, by modeling the behavior pattern using the HMM as a probability model of a time series signal, an unsteady time series signal can be easily modeled. Therefore, the behavior pattern of an object-to-be-detected can be appropriately modeled.

Additionally, according to the information recognition device described in claim 11, in addition to the effects described in any of claims 1 to 7, the likelihood of the behavior pattern model for the first feature data constituted by the spectrum in a frame unit of a detection result and the second feature data constituted by an average amplitude value of the spectrum in the frame unit is calculated, and plural different pieces of attribute information relating to the object-to-be-detected is recognized based on the calculation result, thereby improving the recognition accuracy of the attribute information.

According to the information recognition device described in claim 12, since the value of the spectrum in the frame unit is transformed into the value of a common logarithm as the first feature data, the recognition accuracy of plural different pieces of attribute information can be furthermore improved depending on the condition.

Furthermore, according to the information recognition device described in claim 13, in addition to the first and second feature data, the third feature data constituted by

the difference between the feature indicated by the first feature data of a selected frame and the feature indicated by the first feature data of the frame immediately before the selected frame is used to recognize plural different pieces of attribute information. Therefore, the recognition accuracy of the attribute information can be furthermore improved.

According to the information recognition device described in claim 14, in addition to the first to third feature data, the fourth feature data constituted by the difference between the feature indicated by the second feature data of the selected frame and the feature indicated by the second feature data of the frame immediately before the selected frame is used to recognize plural different pieces of attribute information, thereby furthermore improving the recognition accuracy of the attribute information.

According to the information recognition device described in claim 15, in addition to the effects described in any of claims 1 to 7, a detection result can be visually captured by comparing it with the feature data corresponding to the behavior patterns of other plural objects-to-be-detected, and plural different pieces of attribute information can be visually recognized.

The information recognition method described in claim 16 is realized by the information recognition device, etc. described in claim 1, and the applicability in industry overlaps between the claims. Therefore, the description is omitted here.

Amended Claims

under Art. 34 PCT

1. (Amended) An information recognition device, comprising:

thermal radiation detection means for detecting, by a thermal radiation sensor, thermal radiation emitted from an object-to-be-detected having plural different pieces of attribute information existing in a detection range;

behavior pattern model storage means for storing a behavior pattern model obtained by modeling output of the thermal radiation sensor depending on a behavior pattern of an object-to-be-detected by using a predetermined modeling method; and

information recognition means for recognizing plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result of the thermal radiation detection means and the behavior pattern model stored in the behavior pattern model storage means, wherein

the information recognition means extracts the feature data from the detection result of the thermal radiation detection means, calculates the likelihood between the feature data and the behavior pattern model based on the feature data and the behavior pattern model stored in the behavior pattern model storage means, and recognizes plural different pieces of attribute information relating to the object-to-be-detected based on the calculated likelihood.

2. The information recognition device according to claim 1, wherein

the behavior pattern model storage means stores plural behavior pattern models depending on respective types of behavior patterns.

3. The information recognition device according to claim 1 or 2, further comprising:

behavior pattern model generation means for generating the behavior pattern model of the object-to-be-detected based on the output of the thermal radiation sensor by using the predetermined modeling method.

4. The information recognition device according to any of claims 1 to 3, wherein

the thermal radiation sensor is a thermo-sensor.

5. The information recognition device according to any of claims 1 to 3, wherein

the thermal radiation sensor is a quantum sensor.

6. The information recognition device according to any of claims 1 to 3, wherein

the thermo-sensor is a pyroelectric infrared sensor for detecting infrared emitted from the object-to-be-detected using a pyroelectric effect.

7. The information recognition device according to any of claims 1 to 6, wherein

the predetermined modeling method is an HMM (hidden Markov model).

8. (Canceled)

9. (Canceled)

10. (Canceled)

11. (Amended) The information recognition device according to any of claims 1 to 7, wherein

the feature data comprises first feature data constituted by a spectrum in a frame unit of a detection result of the thermal radiation detection means and second feature data constituted by an average amplitude value of the spectrum in the frame unit.

12. The information recognition device according to claim 11, wherein

the first feature data is obtained by transforming a value of the spectrum in the frame unit into a value of a common logarithm.

13. The information recognition device according to claim 11 or 12, wherein

the feature data further comprises third feature data constituted by a difference between feature indicated by the first feature data of a selected frame and feature indicated by the first feature data of the frame immediately before the selected frame.

14. The information recognition device according to claim 13, wherein

the feature data further comprises fourth feature data constituted by a difference between feature indicated by the second feature data of a selected frame and feature indicated by the second feature data of the frame immediately before the selected frame.

15. (Amended) The information recognition device according to any of claims 1 to 7 and claims 11 to 14, wherein

when the behavior pattern model is constituted by the feature data of a high dimension of four or more, the device comprises:

feature data display means for displaying the feature data corresponding to each behavior pattern model stored in the behavior pattern model storage means as a coordinate point in a two- or three-dimensional space; and

detection result display means for displaying a coordinate point corresponding to a detection result of the thermal radiation detection means in a space in which the coordinate point of the feature data is displayed.

16. (Amended) An information recognition method, comprising:

detecting, by a thermal radiation sensor, thermal radiation emitted from an object-to-be-detected having plural different pieces of attribute information existing in a detection range;

preparing a behavior pattern model obtained by modeling output of the thermal radiation sensor depending on plural types of behavior patterns of plural objects-to-be-detected by using a predetermined modeling method; and

recognizing plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result of the thermal radiation sensor and the behavior pattern model, wherein

in recognizing plural different pieces of attribute information, feature data is extracted from the detection result of the thermal radiation sensor, the likelihood between the feature data and the behavior pattern model is calculated based on the feature data and the behavior pattern model, and plural different pieces of attribute information relating to the object-to-be-detected is recognized based on the calculated likelihood.

17. (Amended) An information recognition program executed by a computer, comprising:

a thermal radiation detecting step of detecting, by a thermal radiation sensor, thermal radiation emitted from an object-to-be-detected having plural different pieces of attribute information existing in a detection range;

a behavior pattern model storing step of storing a behavior pattern model obtained by modeling output of the thermal radiation sensor depending on plural types of behavior patterns of plural objects-to-be-detected by using a predetermined modeling method; and

an information recognizing step of recognizing plural different pieces of attribute information relating to the object-to-be-detected existing in the detection range based on a detection result in the thermal radiation detecting step and the behavior pattern model stored in the behavior pattern model storing step, wherein

in the information recognizing step, feature data is extracted from the detection result in the thermal radiation detecting step, the likelihood between the feature data and the behavior pattern model is calculated based on the feature data and the behavior pattern model stored in the behavior pattern model storing step, and plural different pieces of attribute information relating to the object-to-be-detected is recognized based on the calculated likelihood.

18. (Amended) An alarm system, comprising:

the information recognition device according to any of claims 1 to 7 and claims 11 to 15;

determination means for determining whether or not the object-to-be-detected is a person based on a recognition result of the information recognition device; and

alarm means for raising an alarm when the determination means determines that the object-to-be-detected is a person.